Amendment to Claims

1-18 (cancelled)

19 (new) Method of creating a 2D-image-frame of multiple levels of an optical property using one image frame of a spatial light modulator, for applications in displaying 2D images or one frame of a volumetric 3D images, said optical property comprising a number of basic components, different said basic components being able to be combined to create multiple levels of said optical property; said optical property and said basic components comprising one of the following combinations:

a. color as said optical property and different primary colors as said basic components; or

b. brightness as said optical property and different brightness strengths as said basic components, or

c. polarization as said optical property and different polarization states as said basic components, or

d. phase as said optical property and different phase states as said basic components;

the method including the steps of:

(1) dividing the pixels of the spatial light modulator into a number of groups and defining each group as a sub-panel;

(2) creating an illumination pattern by a pattern generation means, the illumination pattern comprising a 2D distribution of different said basic components;

(3) projecting said illumination pattern onto the spatial light modulator by a projection optics and illuminating each said sub-panel with a light of a different said basic component, thereby each said sub-panel having an illumination beam of a different said basic component, and due to the illumination each said sub-panel also having an output object beam of a different basic component carrying the image of said sub-panel;

(4) recombining the images of said sub-panels by an image combining means to create said 2D-image-frame, said 2D-image-frame thereby comprising composite pixels as its basic picture elements, each said composite pixels having a number of sub-pixels, each said number of sub-pixels being a pixel belonging to a different said sub-panel.

20 (new) Method of claim 19, wherein

the step of creating the illumination pattern including the steps of:

(1) creating a basic pattern of light by illuminating a pattern plate with a light source, the basic pattern comprising an area of light or an array of light spots or light stripes;

(2) projecting said basic pattern by a first lens, and splitting it into multiple paths by a beam splitting means;

(3) adjusting the optical property of each said path by a modulation means such that each said path has a different said basic component;

the step of projecting the illumination pattern including the step of projecting each said path onto one said sub-panel by a second lens.

21 (new) Method of claim 20, wherein said optical property being color and said basic components being primary colors, said beam splitting means and said modulation means comprising one of the following combinations:

a. said beam splitting means comprising a set of non-polarizing beam splitters and said modulation means comprising a set of color filters;

b. said beam splitting means comprising a set of polarizing beam splitters and said modulation means comprising a set of ColorSelect filters;

c. a set of dichroic color reflectors for both beam splitting and modulation;

thereby each said path having a different primary color.

22 (new) Method of claim 20, wherein said optical property being brightness and said basic components being different brightness strengths, said modulation means comprising a brightness modulation means, such as an aperture stop, the brightness modulation means scaling the strengths of illumination on different said paths to a preset ratio.

23 (new) Method of claim20, wherein said pattern plate comprising one of the following means:

a. a shadow mask comprising a transparent plate with reflective patterns on its surface; or

b. a shadow mask comprising a transparent plate with reflective patterns on its surface, further comprising a collector means for recovering transmitted or reflected light; or

c. an aperture plate with a transparent or reflective area; or

d. an array of light re-directing elements such as micro-lens or micro- concave reflectors.

24 (new) Method of claim 20, wherein said spatial light modulator being of reflective type, said image combining means comprising said beam splitting means but operating in reverse directions, said image combining means merging images of said sub-panels into one superimposed frame.

25 (new) Method of claim 19, wherein said optical property being brightness and said basic components being different brightness strengths;

said illumination pattern comprising an array of light elements, such as spots or stripes;

the step of projecting illumination pattern including the step of projecting said illumination pattern onto said spatial light modulator with each said light element covering a number of adjacent pixels such that the averaged illumination intensities on said adjacent pixels are scaled at a preset ratio, each of said adjacent pixels belonging to a different said sub-panel, said preset ratio giving each said sub-panel a different brightness strengths.

26 (new) Method of claim 19, wherein the step of creating the illumination pattern including the step of illuminating a pattern plate with a light source, said pattern plate comprising one of the following means:

a. an array of micro- color filters; or

b. an array of micro- polarization elements; or

c. an array of transparent cells of different thickness or of different index of refraction; or

d. an array of transparent cells containing liquid crystals of different orientations with different phase attenuation effect.

27 (new) Method of 19, wherein

the step of dividing pixels and defining sub-panels dividing the pixels into a number of interlocked groups on the spatial light modulator, the pixel locations of each group spreading over the spatial light modulator, the pixel locations of different groups being interlocked, defining each of said interlocked groups as a sub-panel;

said image combining means displaying the image of the spatial light modulator in full frame, the images of all said sub-panels combining to present said 2D-image-frame of multiple levels of said optical property as viewed in human eyes.

28 (new) Method of claim 19, wherein said image combining means comprising an optical filter means, the optical filter means differentiating and separating the images of different said sub-panels by their different said basic components, said image combining means also comprising a reflector means, said reflector means recombining and superimposing the images of different sub-panels into one image frame.

29 (new) Method of claim 28, wherein said optical property being color and said basic components being primary colors; said optical filter means comprising a set of dichroic color reflectors, said reflector means comprising the same set of dichroic color reflectors.

30 (new) Method of claim 28, wherein said optical property being brightness and said basic components being different brightness strengths,

said spatial light modulator being of micro-mirror type and capable of operating under non-polarized illumination, such as a digital micro-mirror device or a thin-film micro-mirror array;

the step of defining sub-panel defining two sub-panels, s- sub-panel and p- sub-panel;

the step of projecting illumination pattern including the step of polarizing said illumination beams by a polarizing optics and illuminating the p- sub-panel with a p-polarized illumination beam and illuminating the s- sub-panel with a s-polarized illumination beam, also including the step of scaling the illumination intensities of the two beams at a preset ratio by a brightness modulation means;

said optical filter means comprising a polarizing beam splitter for separating the images on the s- sub-panel and on the p- sub-panel, said reflector means comprising a set of reflectors and a TIR prism for redirecting and recombining the images of the two sub-panels.

31 (new) Method of claim 28, wherein said optical property being brightness and said basic components being different brightness strengths,

said spatial light modulator being of liquid crystal type, such as a ferroelectric liquid crystal display;

the step of defining sub-panel defining two sub-panels;

the step of projecting illumination pattern including the step of polarizing said illumination beams by a polarizing optics and illuminating one said sub-panel with a p-polarized illumination beam and illuminating the other with a s-polarized illumination beam, also including the step of scaling the illumination intensities of the two beams at a preset ratio by a brightness modulation means;

said optical filter means comprising a polarizing beam splitter for separating s- and p-light from both said sub-panels, said reflector means comprising a set of reflectors and a TIR prism for redirecting and recombining the images of the two sub-panels;

further including the step of displaying on one said sub-panel with image in s-state and background in p-state, displaying on the other with image in p-state and background in s-state.

32 (new) Method of claim 28, said image combining means further comprising an image projection optics, said image projection optics projecting images of said sub-panels onto a display means and creating said 2D-image-frame.

33 (new) Method of claim 32, further including the step of arranging the incidence angles of said illumination beams such that each said object beam enters said image projection optics with minimum light loss.

34 (new) Method of claim 19, wherein the step of recombining the images of sub-panels including the step of arranging the incidence angles of said illumination beams such that said object beams do not intersect each other at a distance after the spatial light modulator; said image combining means comprising a reflector means, said reflector means recombining said object beams and superimposing the images of different sub-panels into one image frame.

35 (new) Method of claim 34, said image combining means further comprising a number of projection lens, each said projection lens corresponding to one said object beam and projecting the image of one said sub-panel to a display means; said reflector means comprising a set of reflectors after said projection lens to redirect the directions of the projected images from different said sub-panels and superimpose and merge them into one image frame on said display means.

36 (new) Method of claim 19, wherein said spatial light modulator being a ferroelectric liquid crystal display, the method further including the step of displaying successive 2D image frames by displaying all-positive frames successively and then displaying the corresponding inverted frames successively, and the step of applying a polarization rotator to correct the inverted frames.

37 (new) Method of creating multiple 2D-image-frames at high frame rate with one image frame of a spatial light modulator, for applications in displaying 2D images or frames of a volumetric 3D image, the method including the steps of:

(1) dividing the pixels of the spatial light modulator into a number of groups and defining each group as a sub-panel;

(2) creating a basic pattern of light by illuminating a pattern plate with a light source, the basic pattern comprising an area of light or an array of light spots or light stripes;

(3) projecting said basic pattern by a projection optics, splitting said basic pattern into multiple paths by a beam splitting means, projecting each said path onto one different said sub-panel;

(4) modulating each said path by a modulating means and illuminating each said sub-panel sequentially, illuminating only one said sub-panel at a time; further making the total time

period of sequentially illuminating each of the defined sub-panels shorter than one frame period of said spatial light modulator;

(5) recombining the images of said sub-panels by an image combining means, the modulated illumination displaying one sub-panel at a time, one said sub-panel image forming one said 2D-image-frame.

38 (new) Method of claim 37, said beam splitting means or said modulation means further comprising means of adjusting the optical property of each said path such that each said path has a different said basic component.

39. (new) Method of claim 37, wherein said image combining means comprising an image projection optics, said image combining means projecting images of said sub-panels onto a display means and displaying said 2D-image-frames.

40 (new) Method of creating multiple 2D image frames at high frame rate using multiple spatial light modulators, for applications in displaying 2D images or frames of a volumetric 3D image, the method including the steps of:

(1) providing each said spatial light modulator with an illumination source;

(2) displaying a frame of image on each said spatial light modulator;

(3) modulating said illumination source by a modulation means and illuminating each said spatial light modulator sequentially, only one at a time; further making the total time period of sequentially illuminating each of said spatial light modulators shorter than one frame period of said spatial light modulators;

(4) superimposing and displaying the image frames of said spatial light modulators by an image merging means, the modulated illumination displaying one frame from one of said spatial light modulators at a time.

41 (new) Method of 40, wherein said image merging means comprising a projection optics and a set of aligning reflectors after said projection optics, said image projection optics projecting images of said spatial light modulators onto a display means for displaying 2D images or

volumetric 3D images, said aligning reflectors merging the projected image frames of spatial light modulators to a single location on said display means.

42 (new) Method of creating a 2D-image-frame of multiple grayscale with one image frame of a reflective spatial light modulator, the method including the steps of:

(1) dividing the pixels of the spatial light modulator into a number of interlocked groups, the pixel locations of each group spreading over the spatial light modulator, the pixel locations of different groups being interlocked, defining each of said interlocked groups as a sub-panel;

(2) defining composite pixels on the spatial light modulator, each said composite pixel comprising a said number of adjacent pixels of the spatial light modulator, each of said adjacent pixels belonging to one different said sub-panel, defining each of said adjacent pixels of one composite pixel as a sub-pixel of the composite pixel;

(3) providing a pattern plate covering the active surface of the spatial light modulator in proximity, said pattern plate comprising an array of light redirecting or light masking micro-elements;

(4) illuminating the spatial light modulator through said pattern plate with an illumination beam, said pattern plate attenuating said illumination beam such that the averaged illumination intensities over said sub-pixels in every said composite pixel being scaled at a preset ratio, each said sub-panel thereby having a reflected beam of a different illumination intensity, said pattern plate further attenuating said reflected beams to produce an output image frame near the surface of said pattern plate, each said composite pixel displaying multiple levels of brightness by different combinations of different illumination intensities of its sub-pixels, said output image frame forming said 2D-image-frame.

43 (new) Method of claim 42, further including the step of projecting said output image frame to a display means for displaying 2D images or volumetric 3D images by a projection lens to display said 2D-image-frame.

44 (new) Method of creating a 2D-image-frame capable of representing data contents of images of multiple colors or grayscales using one frame of a spatial light modulator, for image processing in optical correlator applications, including the steps of:

(1) dividing the pixels of the spatial light modulator into a number of groups, defining each of said groups as a sub-panel;

(2) defining composite pixels on the spatial light modulator, each said composite pixel comprising a said number of sub-pixels, each said sub-pixel being a pixel of the spatial light modulator, each of said sub-pixels belonging to one different said sub-panel;

(3) assigning a different primary color or brightness strength to each said sub-pixel of said composite pixel, said different brightness strengths being scaled at a preset ratio, thereby every composite pixel being able to represent the data contents of multiple and different colors or brightness levels by different combinations of states of its sub-pixels;

(4) said composite pixel and its sub-pixels forming the basic picture elements of said 2D-image-frame.